Saskatchewan Agriculture and Food

Chickpea in Saskatchewan

Reviewed: March 2006

Introduction

Figure 1. Kabuli chickpea flowering

Chickpea (*Cicer arietinum L.*) is an ancient pulse crop first grown in Turkey about 7,000 B.C. It is traditionally grown in the semi arid zones of India and Middle Eastern countries. A member of the family *Leguminosae*, chickpea has the ability to fix a portion of its nitrogen requirements from air in the soil. The growth habit is erect, with most of the pods formed in the top part of the plant.

Seed size, shape and colour are variable, but typically the seed is beaked and wrinkled or ribbed. The beak is the protruding seedling root tip. There are two commercial classes of chickpea: desi and kabuli. The desi type has a thick, coloured seed coat and coloured flowers. It has a long history of production in the Indian subcontinent, and is split and/or milled to make food products. The kabuli type (also known as garbanzo bean) has a thin, white seed coat and white flowers (Figure 1). It is used mainly in salad and vegetable mixes.

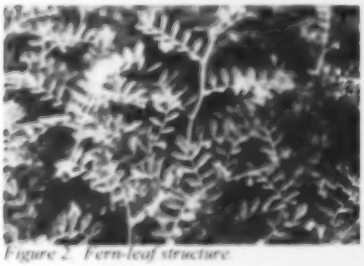


Figure 2. Fern-leaf structure

Chickpea plants range from 30-70 cm (12 - 28 in.) in height. Most chickpea varieties have leaves about 5 cm (2 in.) long with 9 to 15 leaflets, and are described as having a fern-leaf structure (Figure 2).

Figure 3. Unifoliate leaf structure.

Some kabuli varieties, such as CDC Xena, have a single (unifoliate) leaf structure (Figure 3) instead of leaflets.

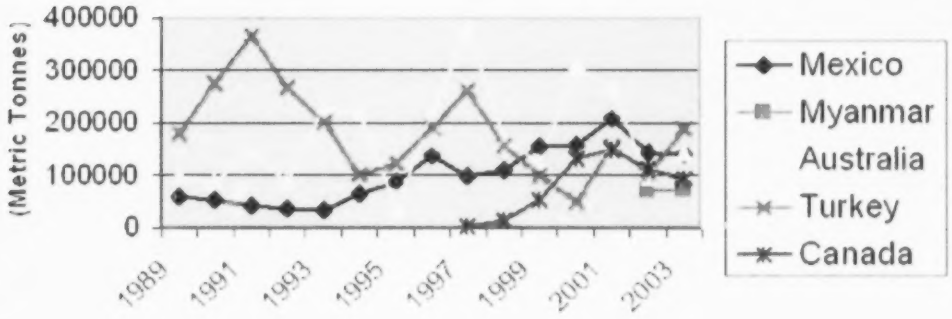
Chickpea pods are short and inflated, and contain one or two seeds. The bushel weight of chickpea is 60 lb.

World chickpea production has ranged from 7-9 million tonnes in recent years. Although chickpea production is approximately four times larger than that of lentil, chickpea world trade is similar to lentil in that India produces and consumes approximately 4–6 million tonnes of mainly desi chickpea each year.

Total world exports have ranged from 500,000–1 million tonnes in 1996-2003. In Saskatchewan, total acreage devoted to chickpea production has increased from 2,400 ha (6,000 acres) in 1996 to over 70,000 ha (172,000 acres) in 2005. Production area peaked at over 400,000 ha (1.1 million acres) in Saskatchewan in 2001, but has subsequently declined in the face of lower world prices and the high production risk caused by plant disease and chickpea's long growing season requirement.

The major chickpea-exporting countries are Turkey, Canada, Australia, Myanmar (Burma) and Mexico (Figure 4). Exports from Turkey and Mexico trended lower in the 1990s, while Australia enjoyed significant increases until crop losses due to disease reduced their production. Canadian chickpea exports have ranged from 6,000-150,000 tonnes in the period from 1996-2004.

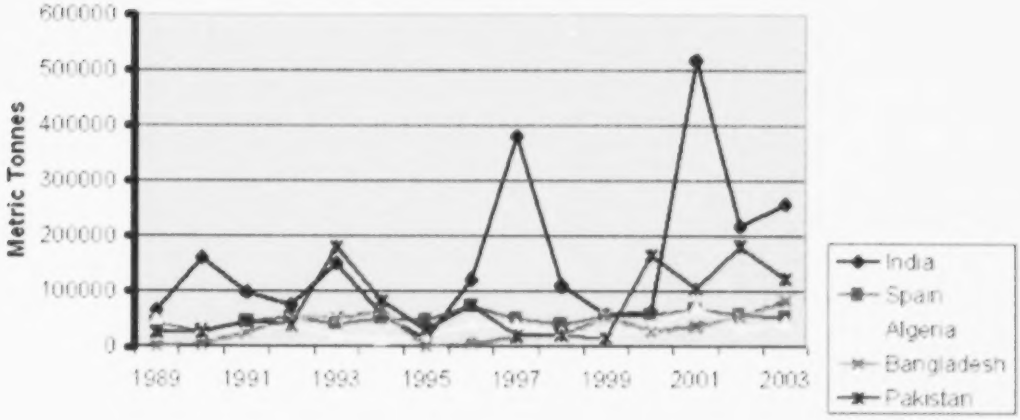
Figure 4. Leading Chickpea Exporting Countries (Source: FAO, 2005)



Market Opportunities

World imports of chickpea have ranged from 400,000-1.1 million tonnes in the period from 1996-2003. The major chickpea-importing countries are India, Bangladesh, Spain, Pakistan and Algeria (Figure 5). Other countries importing chickpea include Iran, Italy, Libya, Lebanon and the U.S. Spain, the U.S. and Italy demand premium quality kabuli chickpea, while India, Bangladesh and Pakistan import both kabuli and desi types. India and Pakistan are responsible for over half of world imports, and will import large volumes of mainly desi chickpea if their domestic crop is small. Due to their close proximity, Myanmar (Burma) and Australia have a marketing advantage over Canada in the Indian subcontinent. However, a significant opportunity exists for Canada in the American, European and Mediterranean chickpea markets.

Figure 5. Leading Chickpea Importing Countries (Source: FAO. 2005)



Nutritional Information

Table 1. Nutrient Profile of chickpea (90 per cent dry matter) for livestock feed (Source: Prairie Feed Resource Centre)

	Desi Seed	Kabuli Seed	Chickpea Straw
Protein (%)	20.5	19.7	4.5 - 6.5
TDN (%)			44 - 46
D.E. (swine) (Kcal/kg)	3200-3400	3400-3500	
M.E. (swine) (Kcal/kg)	2980-3170	3170-3260	
Crude Fibre (%)	9.1	3.4	
Fat (E.E.) (%)	4.8	7.3	
Lysine (%)	1.37	1.29	
Methionine (%)	0.31	0.26	
Threonine (%)	0.73	0.66	

(average basis - individual samples are required for more accurate analysis)

Human consumption nutritional information is available from the Saskatchewan Pulse Growers website: Saskatchewan Pulse Growers website.

Adaptation

Chickpea Production Area Map 2004

Chickpea has an indeterminate growth habit, and will continue to flower while growing conditions remain favourable for vegetative growth. Thus, moisture or nitrogen stress is required to encourage seed set and to hasten maturity. Because of this growth habit, kabuli chickpea is best adapted to the Brown Soil Zone, and desi chickpea is best adapted to the Brown and Dark Brown Soil Zones of Saskatchewan. Figure 6 shows the areas of greatest chickpea production in Saskatchewan in 2004.

Chickpea is not well-adapted to saline soils or to high-moisture areas. It is not well-suited to soils with high clay content or areas where soils are slow to warm in the spring. Chickpea does not tolerate wet or waterlogged soils. Two serious production limitations in Saskatchewan are the long growing season requirement for current varieties and the high risk of the extremely aggressive disease, ascochyta blight. Planting chickpea outside the areas of best adaptation has proven to be very risky due to delayed maturity, high green seed content and destructive disease infections. Chickpea can be planted on either summer fallow or stubble in the Brown Soil Zone and on stubble in the Dark Brown Soil Zone. Planting on stubble fields tends to reduce vegetative growth and results in moisture stress to hasten maturity. Due to the indeterminate growth habit of chickpea, plants can re-grow late in the season after rain showers or in the absence of a killing frost. There are no management practises to overcome the problem of late vegetative re-growth.

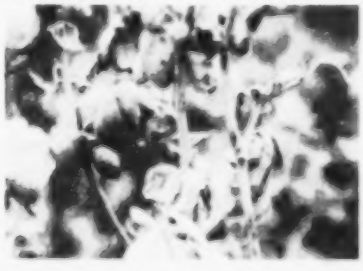
Chickpea is heat-tolerant and thrives under good moisture conditions with daytime temperatures between 21ºC and 29ºC and night temperatures near 20ºC. Chickpea is relatively drought-tolerant due to its long tap root, which allows it to use water from greater depths than other pulse crops.

To prevent delayed or uneven maturity, avoid planting chickpea in low lying areas in the field, around sloughs or in areas with high soil organic matter.

Rotational Considerations

Chickpea production is often successful in rotation with cereal grains such as durum wheat. Chickpea does not leave a lot of crop residue. Growing cereal crops with tall stubble before and after chickpea provides much needed residue to protect the soil from erosion. The Saskatchewan Agriculture and Food publication, Securing Low Erosion Risks after Growing Pulses and Oilseeds, provides more information on reducing soil erosion.

Figure 6. Ascochyta blight infection spreading rapidly on chickpea



Because of the aggressive nature of ascochyta blight of chickpea (Figure 6), careful consideration must be given to crop rotation and field selection. It is recommended that chickpea not be planted in the same field more than once in four years to allow for the breakdown of chickpea residue on which the disease survives. Planting chickpea on chickpea stubble may result in total crop failure and can increase the disease risk to neighbouring fields.

Research carried out by Agriculture and Agri-Food Canada (AAFC), Saskatoon, indicates that the breakdown of ascochyta-blight-infected residue can be accelerated by incorporation into the soil. Residue incorporation does not follow current minimum tillage

practices, but may be required if the chickpea residue was highly infected. Research carried out by AAFC, Swift Current, shows that chickpea can root to a depth similar to wheat or canola (deeper than lentil or pea), and can extract moisture from that depth. Although this characteristic helps chickpea tolerate drought, it also depletes the soil profile of moisture for subsequent crops. This may explain why cereal yields tend to be lower following chickpea compared to lentil or pea.

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Selection of a mostly weed-free field is essential, as few herbicides are registered for use on chickpea. Perennial weeds should be controlled in the years prior to chickpea production. Chickpea is susceptible to the soil residues of some herbicides. It is important to record herbicide use each year and to avoid seeding chickpea in fields with the following herbicide history: TORDON, GRAZON - within the past five years; ALLY, ESCORT – within the past four years; ASSERT, EVEREST, GARLON/REMEDY, SUNDANCE – within the past three years; ACCENT, ATRAZINE, MUSTER, FLAX MAX ULTRA, UNITY, PURSUIT, ODYSSEY, LONTREL, CURTAIL M, PRESTIGE, PREVAIL, SHOTGUN, SPECTRUM, TRITON, BANVEL II (high summer fallow rate) – within the past year; RUSTLER, BANVEL II – following late fall or spring application; 2,4-D – following spring application.

The Saskatchewan Agriculture and Food publication Guide to Crop Protection, contains more information about herbicides and their soil residual properties

Varieties

Most chickpea varieties have leaves with 9 to 15 leaflets. These varieties are described as having a fern-leaf structure. Some kabuli varieties, such as CDC Xena, CDC Diva, Sanford and Dwelley, have a single (unifoliate) leaf structure instead of leaflets. There are currently no varieties with good resistance to ascochyta blight, although breeding efforts are underway. Fern-leaf varieties tend to be less susceptible to ascochyta blight than unifoliate-leaf varieties, and develop symptoms later in the season.

Chickpea plants become most susceptible to ascochyta blight at the flowering stage. Under high disease pressure, even varieties with fair resistance can experience up to 70 per cent yield loss.

Chickpea varieties have been compared in the Saskatchewan regional testing program since 1995. The results (Table 2) are described in the Saskatchewan Agriculture and Food publication, Varieties of Grain Crops.

Table 2. Characteristics of chickpea varieties (Source: SAF 2006)

Variety	Brown Soil Zone	Dark Brown Soil Zone	Height (cm)	Days to Flower	Maturity	Resistance to Ascochyta Blight	Seed weight (g /1000 seeds)	Leaf type
	Yield % of Sanford							
Kabuli Type								
Sanford	100	100	50	57	Very Late	Very Poor	415	unifoliate
CDC ChiChi	117	117	45	53	Late	Poor	385	fern
CDC Diva	104	117	45	52	Late	Very Poor	490	unifoliate
CDC Frontier	164	160	45	55	Late	Fair	375	fern
CDC Xena	117	127	45	52	Late	Very Poor	470	unifoliate
CDC Yuma	113	116	50	53	Very Late	Poor	410	fern
Dwelley	86	88	45	57	Very Late	Very Poor	490	unifoliate
Evans	90	98	50	53	Very Late	Very Poor	430	unifoliate
Amit (B-90)	141	142	50	55	Late	Fair	265	fern
CDC Chico	136	147	45	51	Medium	Poor	265	fern
	Yield % of Myles							
Desi Type								
Myles	100	100	40	50	Medium	Fair	200	fern
CDC Cabri	111	114	45	48	Medium	Fair	295	fern
CDC Desiray	97	108	35	49	Medium	Fair	210	fern
CDC Anna	108	113	40	52	Late	Fair	210	fern
CDC Nika	97	104	40	50	Late	Fair	320	fern

Inoculation

Chickpea is a pulse crop, and has the ability to fix 60-80 per cent of its nitrogen requirement from air in the soil under ideal conditions. For this to occur, the chickpea strain of nitrogen-fixing inoculant (Rhizobium) is required. Chickpea has a very specific relationship with Rhizobium, and it is essential to use an inoculant specifically developed for chickpea. Some chickpea inoculants will be labelled as "garbanzo bean" and are appropriate for use in chickpea. Inoculants for pea and lentil will not produce nodules on chickpea and are not suitable. Under good growing conditions, chickpea is considered a relatively good nitrogen-fixer (similar to lentil), provided that an appropriate Rhizobium inoculant is used. The Saskatchewan Agriculture and Food publication, Inoculation of Pulse Crops, contains more detailed information on the use of nitrogen-fixing inoculants.

Fertilization

Fertility requirements for chickpea are not well-defined. Based on limited data, the requirements for phosphorus, potassium and sulphur are similar to pea or lentil. A well-inoculated crop should not require nitrogen fertilizer, provided the appropriate Rhizobium inoculants are used and nitrogen fixation is optimized. If nitrogen fixation is not optimized due to unfavourable growing conditions (e.g. relatively dry seed bed), chickpea may benefit from low rates of starter N in some years.

In an effort to develop a strategy for dealing with extended maturity, some growers and researchers are testing the application of higher rates of starter nitrogen (applied away from the seed) without inoculant to enhance chickpea's early vegetative growth and to speed crop maturity by causing a nitrogen deficiency in late summer. Figure 7 shows varying maturity of chickpea in research trials at AAFC, Swift Current, in 2004. It is important to note that excessive use of

nitrogen fertilizer, or high levels of available soil nitrogen, reduces nitrogen fixation and may delay maturity. A soil test will provide a guideline for fertility needs.

Figure 7. Chickpea maturity trials.
Source: T. Warkentin

Chickpea seed is very sensitive to seed placed fertilizer. Nitrogen fertilizer should not be placed with the seed. Pulse crops require phosphorus to support healthy growth, hasten maturity and support nitrogen fixation. Under good moisture conditions, 17 kg/ha (15 lb./ac.) actual phosphate can be safely seed placed with a 2.5 cm (1 in.) spread and 15-18 cm (6-7 in.) row spacing. If additional phosphorus is required, side-banding, a wider distribution spread, or the use of Jumpstart® is recommended. If potassium or sulphur (sulphate form) fertilizer is required, it should be side-banded or mid-row-banded. Applications of ammonium sulphate can be broadcast. If irregular patches appear in the field that indicate a possible macronutrient or micronutrient deficiency, conduct a comparative tissue-plus-soil test to determine if a deficiency exists. It is important to remember that irregular patches in the field may be related to disease symptoms. To date, no research has been conducted in Saskatchewan to assess micronutrient requirements of chickpea. Apply test strips of the plant-available form of the possible deficient nutrient(s) and harvest the strips separately to determine whether there is an economic benefit, or improved yield or quality. Contact your soil testing laboratory for diagnostic tissue and soil sampling procedures.

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Seeding

Superior seed quality is needed for successful chickpea production. Seed should be tested at an accredited seed testing laboratory to determine important factors such as percentage of germination, disease levels and seed purity. A 1,000-seed test provides a more accurate test of seed-borne diseases than the standard 400-seed test. The large size and uneven shape of chickpea seed can lead to mechanical seed damage during the seeding operation, and cracked seeds will rarely produce a viable plant. As well, frozen seed should not be used.

Kabuli chickpeas have a very thin, cream-coloured seed coat and are susceptible to Pythium seed rot. The use of a seed treatment is recommended to protect kabuli from this disease, whereas desi chickpea, which has a thick, dark-coloured seed coat, does not usually require a seed treatment to protect it from *Pythium*. Both kabuli and desi chickpea are susceptible to other rots and blights (see Disease Control).

As well as being residue-borne, ascochyta blight is highly seed-borne. The transmission of the disease from the seed to the seedling is common in chickpea; therefore, seed to be planted should be tested for the presence of ascochyta. Growers should use seed with as close to zero per cent seed-borne ascochyta as possible. Saskatchewan Crop Insurance Corporation has set maximum seed-borne ascochyta infection levels in chickpea seed at 0.3 per cent in order to

qualify for a crop insurance claim where the cause of loss was ascochyta blight. CROWN and APRON MAXX RTA seed treatment fungicides are registered for the control of seed-borne ascochyta in chickpea.

The Saskatchewan Agriculture and Food publication, Guide to Crop Protection, contains more information on the use of seed treatments.

Seed treated with a fungicide should be allowed to dry prior to applying nitrogen-fixing inoculant. Once inoculated, plant as soon as possible, as delays can reduce the efficacy of the inoculant. Granular inoculants are less affected by fungicide seed treatments than other forms of inoculants because the granules are separated from the seed.

The proper seeding depth for chickpea is 3.5-6 cm (1.5 2.5 in.). Chickpea should be seeded into moist soil to provide the necessary moisture for proper germination and inoculant survival. Seeding rates depend on seed size, seed germination and survival percentage. Seeding rates range from 90-105 kg/ha (80 95 lb./ac.) for desi types to 135-210 kg/ha (120 190 lb./ac.) for kabuli types. The desired plant population is 33-44 seedlings/m2 (3-4/ft.2). Crop stands of this density provide better competition against weeds and will result in more uniform maturity and higher yields. The following formula should be used to determine the seeding rate for chickpea.

$$\text{Seeding rate (lb./ac.)} = \frac{\text{(population/ft.2 x 1000 seed wt. g)x 10}}{\text{\% field emergence or survival}}$$

Research was carried out by AAFC, Swift Current, to determine if large kabuli chickpea seed can be screened and sized before planting. The results indicated that the 9 and 10 mm seeds could be removed from the seed lot and sold into the commercial market, and that 8 mm seeds could be used for planting, with no yield penalty or loss in seed size as long as the smaller seeds did not have an increased percentage of seed-borne diseases. Planting only 7 mm seeds of the large kabuli varieties is not recommended because they may have reduced seedling vigour.

The recommended minimum average soil temperature at depth of seeding for desi chickpea is 7°C. This is slightly higher than the minimum average soil temperature recommended for dry pea and lentil. The minimum average soil temperature at depth of seeding for kabuli chickpea should be 10°C. Kabuli chickpea has a very thin seed coat and is easily infected by soil-borne fungi. Warmer soil is required for rapid germination and emergence of seedlings. Planting should take place as soon as the soil reaches these temperatures in order to provide enough time for the crop to mature before the first fall frost. In Saskatchewan, chickpea should not be planted much later than May 24 due to the crop's long growing season requirement.

Land Rolling

Land rollers are less beneficial in chickpea production than in pea and lentil production, since chickpea does not usually lodge and the stubble height is greater. Rolling of chickpea fields should only be done before crop emergence. Post-emergent land rolling is not recommended, as it may spread disease such as ascochyta blight and can cause mechanical injury because chickpea seedlings develop stiff stems early in their development.

Weed Control

Chickpea is a poor competitor with weeds. Post-emergent harrowing is not recommended, as it can spread disease and cause severe crop injury. Using the correct seeding date and optimum plant densities are the best ways to ensure the crop has the opportunity to compete with weeds.

A pre-emergent burn-off with a non-selective glyphosate herbicide can be used to control winter annual and early emerging spring annual weeds.

Herbicide testing indicates that chickpea is especially sensitive to many post-emergent herbicides registered for the control of broadleaf weeds in lentil or pea. SENCOR (metribuzin) herbicide is registered for suppression of some broadleaf weed seedlings in chickpea. Application should take place at the 1 to 3 above-ground node stage (maximum crop height 6 cm). Application past this crop stage can lead to significant crop injury. Clethodim-based herbicides (SELECT/CENTURION) are registered for control of annual grassy weeds in chickpea. Application should take place at the 2- to 6-leaf stage of the grassy weeds. POAST ULTRA is registered for the control of annual grassy weeds in chickpea. Application should take place at the 1- to 6-leaf stage of the grassy weeds.

Consult the product label or the Saskatchewan Agriculture and Food publication, *Guide to Crop Protection*, for more information on the use of herbicides.

It is very important to control perennial weeds, such as Canada thistle or sow thistle, in the years prior to chickpea. Volunteer canola, mustard and flax are difficult to control, and rotations that include these crops should be avoided prior to chickpea production. Low rates (280g ai/ha) of 2,4-D can also be used from mid-October until freeze-up to control broadleaf winter annual weeds such as stinkweed, shepherd's-purse and flixweed. Chickpea is sensitive to the soil residues of a number of herbicides (see Rotational Considerations), and to herbicide drift. Producers should inform their neighbours about the location of their chickpea crops, and thoroughly clean their sprayer tanks before applying any crop protection product on chickpea.

Disease Control

A complex of pathogens can cause seed rot, seedling blight and root rot of chickpea, including species of *Pythium, Fusarium, Rhizoctonia* and *Botrytis*. Seed rots and seedling blights are most severe when soil is cool or saturated and seedling emergence is delayed. Infected seed may fail to germinate. Infected seedlings will usually turn yellow and then wilt and die. Stems may be girdled and discoloured at or just below the soil surface; roots may be rotten, allowing the plants to be pulled easily from the soil. Kabuli chickpea is especially susceptible to rots due to its thin, zero-tannin seed coat. ALLEGIANCE FL, APRON FL and APRON MAXX RTA are seed treatment fungicides registered for control of seed rot and seedling blight caused by *Pythium*. These seed treatments are not usually required with desi chickpea because of its thick, dark-coloured seed coat, which contains tannins that have a fungistatic effect against *Pythium*. MAXIM 480 FS and APRON MAXX RTA are registered for the control of seedling diseases caused by *Fusarium* spp. and *Rhizoctonia* spp. CROWN and APRON MAXX RTA are seed treatments registered for the control of seed-borne ascochyta. Rhizobium inoculants can be affected by seed treatments (see Seeding), so labels should be checked to ensure that the products are compatible.

Chickpea is also susceptible to botrytis grey mould, both at the seedling stage and in advanced stages. Botrytis grey mould of seedlings may spread down a seed row, resulting in a series of yellow or dead seedlings. Botrytis grey mould is also favoured later in the growing season by dense canopies and moist conditions. Botrytis is usually most evident after flowering, and is common on pods, resulting in shrunken, discoloured seed. The infected area is often covered by a dark grey, fuzzy fungal growth. LANCE® fungicide is registered for the control of late-season development of botrytis grey mold on chickpea.

Ascochyta blight is a foliar disease that can completely destroy a chickpea crop. It is caused by a fungal pathogen (Ascochyta rabiei) that is both seed- and residue-borne.

Figure 8. Ascochyta blight infection on chickpea.

Ascochyta blight of chickpea is much more aggressive than ascochyta blight of lentil or pea, and is caused by a different Ascochyta species. Symptoms include tan or brown lesions on stems, leaves and pods (Figure 8). The lesions may girdle entire stems, causing them to wilt and die. Dark fruiting bodies, called pycnidia, are formed in the lesions. The pycnidia ooze spores in wet and humid conditions. Spores are spread by rain, thus infection is aided by weather with frequent showers. Plants will show lesions approximately four to seven days following infection. If weather turns warm and dry, infected plants may survive, but will be delayed in maturity and produce lower yields. Ascochyta blight is also seed-borne, so the use of disease free seed is critical. It is also capable of surviving for several years on crop residues in the soil. A minimum four-year crop rotation will reduce the risk of infection.

Another consideration in disease control is the selection of varieties with "fair" instead of "poor" or "very poor" ratings (Table 2) for ascochyta. A key goal of the Crop Development Centre chickpea breeding program is improved ascochyta blight resistance.

Research carried out at AAFC, Saskatoon, has identified 15 races of Ascochyta rabiei in Western Canada. This indicates the broad range of variation in the disease. Both mating types of the pathogen causing ascochyta blight of chickpea have been identified in Saskatchewan. This allows for sexual recombination, and the potential change in virulence of the pathogen to overcome varietal resistance. The sexual stage also results in the development of air-borne ascospores, aiding in long-distance disease transmission.

Early and regular scouting is essential. Fungicide application must occur immediately upon discovery of the first lesion. Applications may have to be initiated as early as the seedling stage.

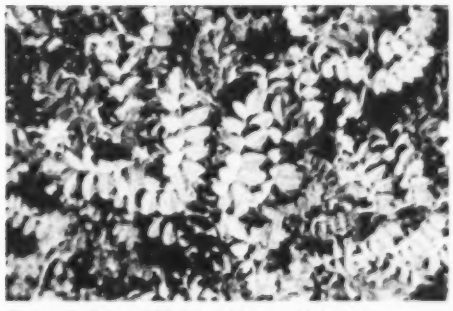

Figure 9. Bravo 500 fungicide on chickpea.

BRAVO 500 is registered for the control of ascochyta blight in chickpea. A number of applications may be required, and may not completely eliminate the disease. BRAVO 500 (Figure 9) is a protective fungicide; therefore, it will not protect new tissue that develops after application, nor will it stop disease lesions that have already developed.

HEADLINE EC and QUADRIS are also registered for the control of ascochyta blight in chickpea. LANCE is registered for the control of ascochyta blight, sclerotinia stem rot and botrytis grey mould in chickpea. HEADLINE EC, QUADRIS and LANCE have both protective and curative abilities.

HEADLINE EC and QUADRIS are members of the strobilurin group of fungicides. Resistance of several fungal pathogens to this group of fungicides has been reported in Europe and is of great concern. No more than two applications per year of any strobilurin fungicide should be made to the same field, as disease resistance to strobilurin could develop. The continuous use of strobilurin fungicides without fungicide rotation greatly increases the threat of resistance developing in the pathogen population.

LANCE is a member of the anilid class of fungicides. It has a different mode of action than the strobilurins. The maximum application restriction for LANCE is two applications per season.

A specific rotation of fungicides cannot be recommended at this time, due to lack of data. However, research to date indicates that an early, pre-blooming application is most effective in preventing disease build-up in the field, regardless of which fungicide product is used.

More information on ascochyta blight in chickpea can be found in Saskatchewan Agriculture and Food's CD ROM, Ascochyta Blight of Chickpea, and the Management of Ascochyta Blight of Chickpea in Saskatchewan (see Additional Information).

The Saskatchewan Agriculture and Food website contains updated information on ascochyta blight of chickpea entitled *Guidelines for Disease Scouting and Foliar Fungicide Applications for Ascochyta Blight in Chickpea in Saskatchewan.*

Chickpea grown in conditions of high rainfall and dense crop canopies is susceptible to sclerotinia stem rot. This disease is more common in crop rotations that include other susceptible broadleaf crops such as canola, mustard, lentil or pea. Symptoms usually occur in patches, typically in heavier areas of the crop. Infected plants are initially pale green, and the diseased tissue may be covered by a white, cottony fungal growth. The plant later becomes bleached in colour, and the infected area will easily shred apart, revealing small black fungal resting structures. LANCE fungicide is registered for the control of sclerotinia stem rot on chickpea.

Insect Control

Chickpea leaves, stems and pods are hairy and secrete malic acid that makes the plant less attractive to insects. Insects reported to be pests of chickpea in Western Canada include wireworms, alfalfa loopers, aerial or above-ground feeding cutworms (i.e. red-backed cutworms) and grasshoppers in the early seedling development stage. Leaf-mining larvae have been noted on lower leaves of chickpea, pea and lentil in recent years, with no notable effects on yield. MATADOR 120EC is registered on chickpea for the control of grasshoppers, potato leafhoppers and cutworms. Check the MATADOR label for more information.

Chickpea seedlings are also very attractive to rabbits and deer, and may be grazed to economic loss.

Desiccation

REGLONE DESICCANT is a registered desiccant on chickpea. REGLONE DESICCANT will not speed maturity of green crops. It should be applied when plants have yellowed, the pods have matured, and seeds have changed colour and detached themselves from the pods. Aerial application is not registered on chickpeas. Consult the label or the SAF publication, Guide to Crop Protection, for more information about the use of desiccants.

Harvesting

The average yields of desi and kabuli chickpea in Saskatchewan are approximately 1,550 kg/ha (1,400 lb./ac.) and 1,300 kg/ha (1,150 lb./ac.), respectively. Chickpea plants have stiff stems and a relatively upright growth habit, with pods developing several inches above the ground. Intact pod loss can occur as a result of breakage of the small stem that attaches the pod to the plant. Under the drought conditions in 2001, some chickpea growers reported shattering of maturing pods.

Maturing desi chickpea that is subjected to heat or drought stress can exhibit red to purple leaves, stems and pods (Figure 10). This purpling is a result of an accumulation of naturally occurring plant pigments called anthocyanins. This colour change often occurs on the side of the

plant facing the sun, and has not been found to negatively affect yield or quality of the grain beyond that caused by heat and drought stress.

Figure 10. Red pigment on desi chickpea.

Chickpea is usually straight-cut, but can be swathed ahead of the combine if straight-cut equipment is not available. Swathing should be done when the plants are slightly damp in order to reduce intact pod loss. Wind can damage swaths.

In an attempt to hasten maturity, some growers have tried swathing while the pods are still green. This has caused an increase in green seed in the harvested crop and a loss of grade. Best results usually occur if combining is delayed until the majority of the pods and plants are fully mature. This may require harvesting the field in stages, leaving immature areas to a later date.

Combine when the seed is at approximately 18 per cent moisture. Initial combine settings should be similar to those used for dry pea; however, a wider concave setting for larger seeds, and an increased cylinder or rotor speed may be required to remove the seed from the pod. Care must be taken not to damage the seed, especially with the large kabuli types. Safe storage is at 14 per cent moisture or less. Chickpea seed colour is an important grading factor. The stage of the crop should be closely monitored, as harvesting too early increases the chance of green seed in the crop, which lowers the grade and value of the grain (Figure 11). Deductions are implemented if immature green seeds comprise more than 0.5 per cent in kabuli and one per cent in desi chickpea. Early frost can also result in immature green seed in the harvested crop, and is common in regions outside the areas best adapted for the crop. This will significantly reduce the grade and value of the crop. Other factors that negatively effect quality are Botrytis or Sclerotinia in the seed, admixtures, small seed size and a lack of seed uniformity.

Storage and Handling

Chickpea should be handled in a manner similar to other pulse crops. The irregular seed shape with the exposed beak can lead to increased mechanical damage when handling. The use of conveyors instead of augers can reduce damage. Aeration can improve storage by reducing seed moisture and temperature. Seed should be stored at 14 per cent moisture or less. Stored chickpea should be checked at intervals for moisture and temperature levels to avoid spoilage loss.

The Canadian Grain Commission has developed grading standards and a moisture conversion table for chickpea. Grading is done on the basis of seed colour, damaged seed, cracked seed coats, green seed and foreign material. However, kabuli chickpea prices are often determined by the percentage of seed in each size class (for example: 10mm, 9mm, 8mm, 7mm). The percentage of each size class is most often determined as it exits the cleaning equipment in the processing plant (described as "net off the cleaner"). Growers are advised that the percentage of each seed size class determined in the pre-cleaning sample may not be the same as net off the cleaner, and the grower and processor should agree beforehand how payment will be based.

Supplemental heat drying of chickpea should be limited to temperatures below 45° C.

Marketing

A list of special crop marketing companies is available in the Saskatchewan Agriculture and Food publication, *Saskatchewan Special Crop Marketing Company Synopsis*.

Economics of Production

The Saskatchewan Agriculture and Food publication, *Crop Planning Guide – Specialty Crops*, contains information on projected costs of production and expected returns on desi and kabuli chickpea in Saskatchewan.

Additional Information

- Saskatchewan Agriculture and Food
    - Agriculture Knowledge Centre:1 (866) 457-2377
    - Website address: www.agr.gov.sk.ca
        - Guidelines for Disease Scouting and Foliar Fungicide Applications for Ascochyta Blight in Chickpea in SK
- SAF publications: *Guide to Crop Protection*, *Varieties of Grain Crops*, *Inoculation of Pulse Crops*, *Ascochyta Blight of Chickpea*, *Soil Improvement with Legumes*, *Introducing Alternative Crops to the Brown Soil Zone*, *Saskatchewan Special Crop Marketing Company Synopsis*, *Crop Planning Guide - Specialty Crops*, *Securing Low Erosion Risks after Growing Pulses and Oilseeds*
- *Management of Ascochyta Blight of Chickpea in Saskatchewan* – CD-ROM. To obtain a free copy call: 1 (866) 457-2377

Saskatchewan Pulse Growers website - Pulse Production Manual available at (306) 668-5556

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